EUROPEAN 'KANGAROO' MATHEMATICAL CHALLENGE
'PINK'
Thursday 16th March 2017

Organised by the United Kingdom Mathematics Trust and the Association Kangourou Sans Frontières

This competition is being taken by 6 million students in over 50 countries worldwide.

RULES AND GUIDELINES (to be read before starting):

1. Do not open the paper until the Invigilator tells you to do so.

2. Time allowed: **1 hour**.
   No answers, or personal details, may be entered after the allowed hour is over.

3. The use of rough paper is allowed; **calculators** and measuring instruments are **forbidden**.

4. Candidates in England and Wales must be in School Year 10 or 11.
   Candidates in Scotland must be in S3 or S4.
   Candidates in Northern Ireland must be in School Year 11 or 12.

5. **Use B or HB pencil only**. For each question, mark *at most one* of the options A, B, C, D, E on the Answer Sheet. Do not mark more than one option.

6. Five marks will be awarded for each correct answer to Questions 1 - 15.
   Six marks will be awarded for each correct answer to Questions 16 - 25.

7. *Do not expect to finish the whole paper in 1 hour*. Concentrate first on Questions 1-15. When you have checked your answers to these, have a go at some of the later questions.

8. The questions on this paper challenge you **to think**, not to guess. You get more marks, and more satisfaction, by doing one question carefully than by guessing lots of answers.

Enquiries about the European Kangaroo should be sent to: Maths Challenges Office, School of Mathematics Satellite, University of Leeds, Leeds, LS2 9JT.

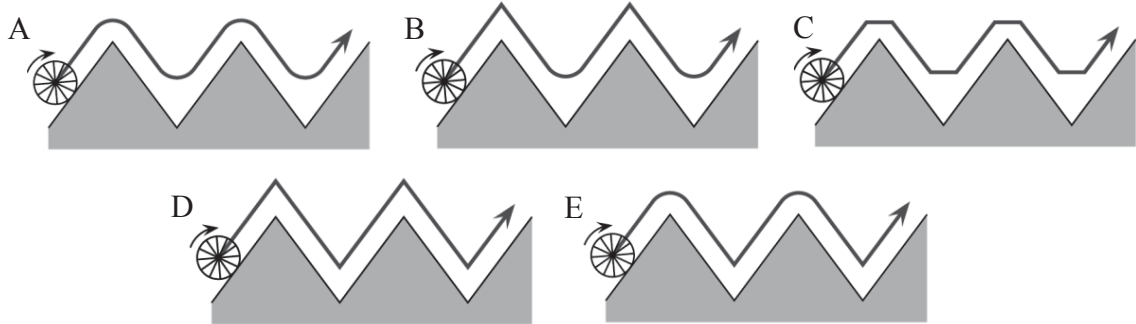*(Tel. 0113 343 2339)*

http://www.ukmt.org.uk

1. In the number pyramid shown each number is the sum of the two numbers immediately below. What number should appear in the left-hand cell of the bottom row?

	2039
	2020
?	2017
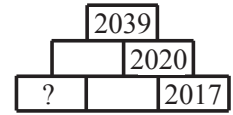
   A 15   B 16   C 17   D 18   E 19

2. Which of the following diagrams shows the locus of the midpoint of the wheel when the wheel rolls along the zig-zag curve shown?

3. Some girls were dancing in a circle. Antonia was the fifth to the left from Bianca and the eighth to the right from Bianca. How many girls were in the group?

   A 10   B 11   C 12   D 13   E 14

4. A circle of radius 1 rolls along a straight line from the point K to the point L, where $KL = 11\pi$. Which of the following pictures shows the correct appearance of the circle when it reaches L?

5. Martina plays chess. She has played 15 games this season, out of which she has won nine. She has five more games to play. What will her success rate be in this season if she wins all five remaining games?

   A 60%   B 65%   C 70%   D 75%   E 80%

6. One-eighth of the guests at a wedding were children. Three-sevenths of the adult guests were men. What fraction of the wedding guests were adult women?

   A $\dfrac{1}{2}$ B $\dfrac{1}{3}$ C $\dfrac{1}{5}$ D $\dfrac{1}{7}$ E $\dfrac{3}{7}$

7. A certain maths teacher has a box containing buttons of three different colours. There are 203 red buttons, 117 white buttons and 28 blue buttons. A student is blindfolded and takes some buttons from the box at random. How many buttons does the student need to take before he can be sure that he has taken at least 3 buttons of the same colour?

   A 3   B 4   C 6   D 7   E 28

8. As shown in the diagram, *FGHI* is a trapezium with side *GF* parallel to *HI*. The lengths of *FG* and *HI* are 50 and 20 respectively. The point *J* is on the side *FG* such that the segment *IJ* divides the trapezium into two parts of equal area. What is the length of *FJ*?
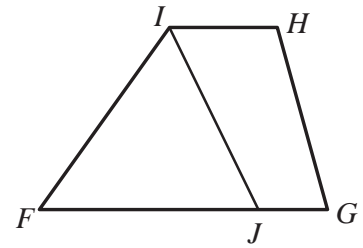
   A 25   B 30   C 35   D 40   E 45

9. How many positive integers *N* possess the property that exactly one of the numbers *N* and $(N + 20)$ is a 4-digit number?

   A 19   B 20   C 38   D 39   E 40

10. The sum of the squares of three consecutive positive integers is 770. What is the largest of these integers?

    A 15   B 16   C 17   D 18   E 19

11. A belt drive system consists of the wheels *K*, *L* and *M*, which rotate without any slippage. The wheel *L* makes 4 full turns when *K* makes 5 full turns; also *L* makes 6 full turns when *M* makes 7 full turns. The perimeter of wheel *M* is 30 cm. What is the perimeter of wheel *K*?
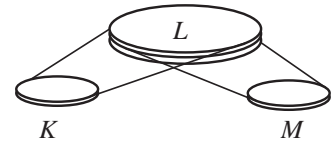
    A 27 cm   B 28 cm   C 29 cm   D 30 cm   E 31 cm

12. Tycho wants to prepare a schedule for his jogging for the next few months. He wants to jog three times per week. Every week, he wants to jog on the same days of the week. He never wants to jog on two consecutive days. How many schedules can he choose from?

    A 6   B 7   C 9   D 10   E 35

13. Four brothers have different heights. Tobias is shorter than Victor by the same amount by which he is taller than Peter. Oscar is shorter than Peter by the same amount as well. Tobias is 184 cm tall and the average height of all the four brothers is 178 cm. How tall is Oscar?

    A 160 cm   B 166 cm   C 172 cm   D 184 cm   E 190 cm

14. Johannes told me that it rained seven times during his holiday. When it rained in the morning, it was sunny in the afternoon; when it rained in the afternoon, it was sunny in the morning. There were 5 sunny mornings and 6 sunny afternoons. Without more information, what is the least number of days that I can conclude that the holiday lasted?

    A 7   B 8   C 9   D 10   E 11

15. Maja decided to enter numbers into the cells of a 3 × 3 grid. She wanted to do this in such a way that the numbers in each of the four 2 × 2 grids that form part of the 3 × 3 grid have the same totals. She has already written numbers in three of the corner cells, as shown in the diagram. Which number does she need to write in the bottom right corner?

    A 0   B 1   C 4   D 5   E impossible to determine

16. Seven positive integers *a*, *b*, *c*, *d*, *e*, *f*, *g* are written in a row. Every number differs by one from its neighbours. The total of the seven numbers is 2017. Which of the numbers can be equal to 286?

    A only *a* or *g*   B only *b* or *f*   C only *c* or *e*   D only *d*   E any of them

17. Niall's four children have different integer ages under 18. The product of their ages is 882. What is the sum of their ages?

    A 23   B 25   C 27   D 31   E 33

18. Ivana has two identical dice and on the faces of each are the numbers $-3, -2, -1, 0, 1, 2$. If she throws her dice and multiplies the results, what is the probability that their product is negative?

    A $\dfrac{1}{4}$ B $\dfrac{11}{36}$ C $\dfrac{1}{3}$ D $\dfrac{13}{36}$ E $\dfrac{1}{2}$

19. Maria chooses two digits a and b and uses them to make a six-digit number $ababab$. Which of the following is always a factor of numbers formed in this way?

    A 2   B 5   C 7   D 9   E 11

20. Frederik wants to make a special seven-digit password. Each digit of his password occurs exactly as many times as its digit value. The digits with equal values always occur consecutively, e.g. 4444333 or 1666666. How many possible passwords can he make?

    A 6   B 7   C 10   D 12   E 13

21. Carlos wants to put numbers in the number pyramid shown in such a way that each number above the bottom row is the sum of the two numbers immediately below it. What is the largest number of *odd* numbers that Carlos could put in the pyramid?
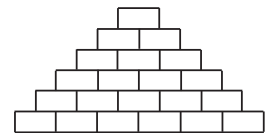
    A 13   B 14   C 15   D 16   E 17

22. Liza found the total of the interior angles of a convex polygon. She missed one of the angles and obtained the result 2017°. Which of the following was the angle she missed?

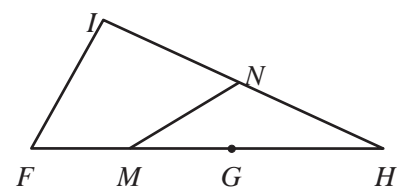   A 37°   B 53°   C 97°   D 127°   E 143°

23. On a balance scale, three different masses were put at random on each pan and the result is shown in the picture. The masses are of 101, 102, 103, 104, 105 and 106 grams. What is the probability that the 106 gram mass stands on the heavier pan?

    A 75%   B 80%   C 90%   D 95%   E 100%

24. The points G and I are on the circle with centre H, and FI is tangent to the circle at I. The distances FG and HI are integers, and $FI = FG + 6$. The point G lies on the straight line through F and H. How many possible values are there for HI?
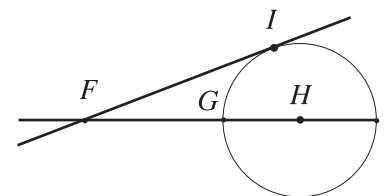
    A 0   B 2   C 4   D 6   E 8

25. The diagram shows a triangle FHI, and a point G on FH such that $GH = FI$. The points M and N are the midpoints of FG and HI respectively. Angle $NMH = \alpha°$. Which of the following gives an expression for $\angle IFH$?

    A $2\alpha°$ B $(90 - \alpha)°$ C $45 + \alpha°$ D $(90 - \tfrac{1}{2}\alpha)°$ E $60°$